Diabetes Detection System

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ABSTRACT

This thesis proposes the development of Diabetes Detection System (DDS) capable of detecting potential diabetes based on the rule-based technique. Specifically, DDS enables the user to select the symptoms that they have without having to see the doctor as part of early screening. Using these symptoms, DDS determines whether or not the user is potentially at risk for diabetes. In the current version, DDS is capable to detect three possible outcomes: Healthy, Diabetic Type 1, and Diabetic Type 2. Implemented using Adobe Dreamweaver CS6 and XAMPP, DDS adopts forward-chaining rules with live input data against the conditions (IF parts) of the rules. DDS represents our research vehicle to investigate the applicability of rule-based technique for symptomatic diseases.

ABSTRAK

Thesis ini mencadangkan pembangunan sebuah sistem yang mampu mengesan seseorang itu menghidap penyakit kencing manis berdasarkan teknik yang dikenali sebagai "rule-based".Sistem ini dikenali sebagai Diabetes Detection System (DDS), yang dibangunkan untuk diaplikasikan dalam telefon mudah alih. Khususnya, DDS membolehkan pengguna untuk memilih gejala-gejala yang mereka hadapi tanpa perlu berjumpa doktor untuk tujuan pemeriksaan awal. Melalui pemilihan gejala-gejala ini, DDS menentukan sama ada pengguna berpotensi untuk menghidap penyakit kencing manis. Dalam versi semasa, DDS mampu untuk mengesan tiga kemungkinan: Sihat, Type 1 kencing manis, dan kencing manis Type 2. Sistem ini telah dihasilkan dengan menggunakan Adobe Dreamweaver CS6 dan XAMPP.Teknik yang digunakan DDS adalah merujuk kepada "forward-chaining" dengan output dikesan secara langsung melalui "rules" yang telah dibentuk.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Medical practitioners are often sought for anywhere. Their jobs are often considered noble as they help to save lives. Typically, in many developing countries, the ratio of doctors to patient is significantly low (i.e. suggesting the need for more doctors). Consequently, doctors are often overworked and have to deal with many cases.

In order to alleviate the burden of a doctor, a system that provides an early warning can be of help. In particular, this research is a step in the aforementioned direction. Diabetes Detection System is a mobile application for early screening of diabetes disease based on the symptomatic selection from the given rules. Ideally, the system is designed to be user friendly. To access the Diabetes Symptom Test, users need to register themselves and answer a few questions on symptom that they may have. This system works by identifying the stage of diabetes based on the symptoms selection via the pre-defined medical rules. Additionally, the user is able to view basic information regarding diabetes and advice for diabetes managed in future. Also, this system is designed for help the user to identify their BMI record. The users will able to know whether they are healthy or overweight through the BMI calculation.

The main benefit of this system is the fact that it can help the users to save time and reduce cost to see a doctor in order to identify whether they were affected with diabetes Mellitus at early stage. Early detection through symptom selection enables the users to control and take early prevention steps in order to gain healthy body and free from diabetes.

Arguably, health issues are one of the serious matters that directly affect the well-being of our community. One of the major health problems that faced by the community members are the diabetes Mellitus diseases. Thus, these systems have been developing to help to reduce the time between the patient and doctor in order to identify whether they have diabetes by symptomatic selection.

1.2 PROBLEM STATEMENT

Nowadays, health problems in our country are increasing rapidly especially diseases that related to blood disorders. There are many types of blood disorder diseases, such as diabetes, anemia, blood cholesterol, hemophilia, HIV/AIDS, leukemia, cancer and so on. Diabetes Mellitus affects nearly 400 million in worldwide. In Malaysia hundreds of thousands of people are afflicted with this chronic disease. Thus, in order to identify their health condition, these systems have been developed. Usually, the user or people need to go for manual checkup that is the medical laboratory test (lab blood test) to gain the results regarding their health condition.

Basically, this manual checkup consumes more time and expenses. Furthermore, people nowadays are having difficulty to seek the doctor or undergoes any medical checkup in order to get knows their body health due to increasing workload which lead to insufficient of time. This is the reason we develop diabetes detection system using mobile. This application can help reduce time between doctor and patient

Diabetes is a chronic disease that has no cure, where the body is unable to produce Insulin hormone as normal body do. Diabetes is a disease which due to the blood glucose level is too high in the body. As we know, normal body obtained blood glucose level from the meal that human take daily and the insulin hormone is very important in providing energy to body. However, excessive or high glucose level in body can cause many serious problems such as it can damage eyes, kidney, and nerves. Usually, due to lack of knowledge about diabetes is the reason diabetic patient does no know to self-manage their illness. Thus, the developed system will help the diabetic patient to monitor their disease and will provide complete information about diabetes.

Diabetes Detection System (DDS) is an online system that facilitates early warning of diabetes. This application is web mobile application that allows user to access from everywhere and with basic computer knowledge.

1.3 OBJECTIVES

The aim of this project is to develop an expert system as early warning system for Diabetes detection using Rule Based approach. To achieve the aim the objectives are

i. To develop a web mobile application in order to identify diabetes type base on diabetes symptom.
ii. To develop an algorithm using Rule-based to identify diabetes type base on diabetes symptom.
iii. To provide the early awareness and information regarding this disease so that the individual would take action to prevent it as quickly as possible.

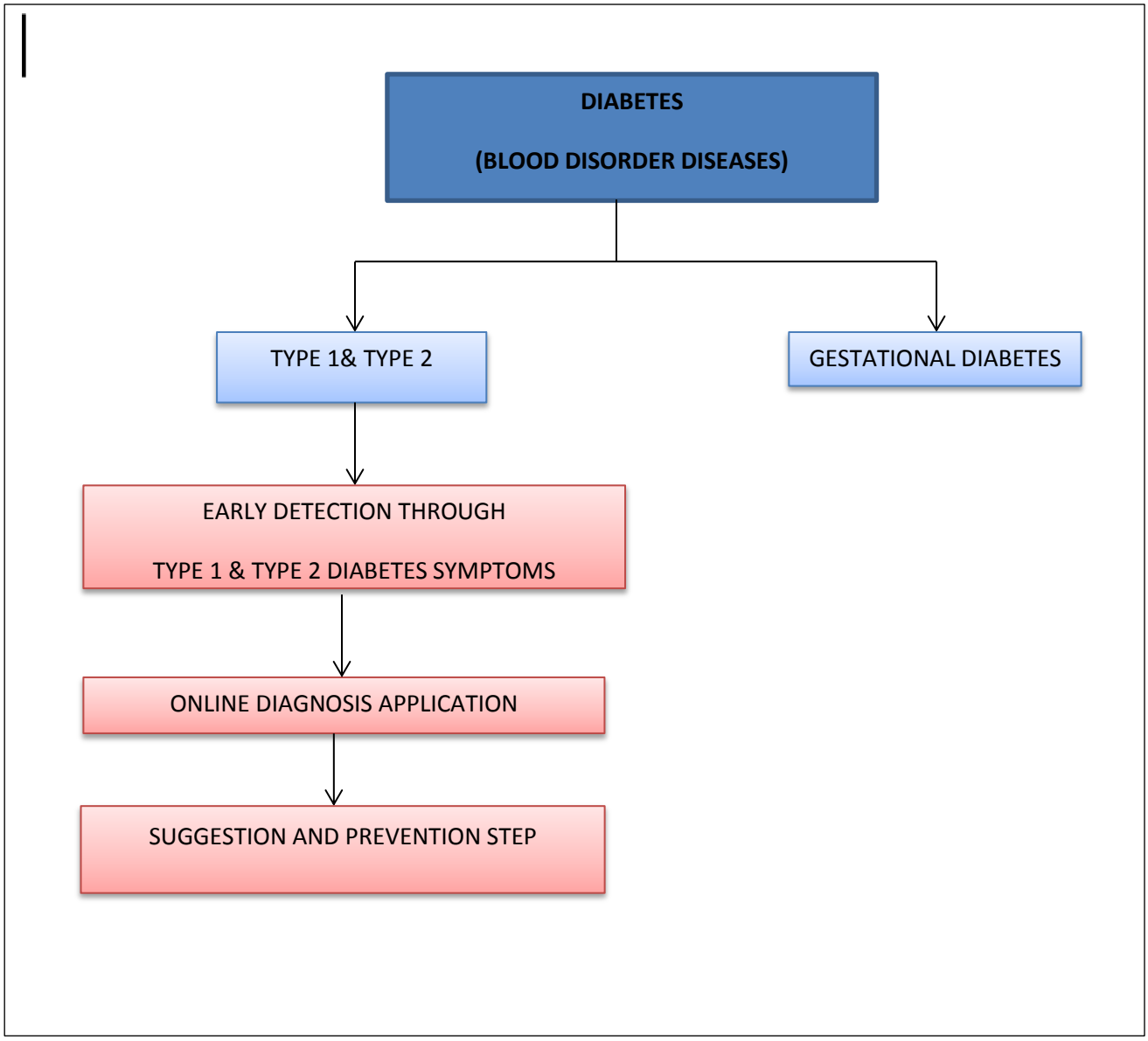
1.4 SCOPE

This system is developed for public use and it uses resources from diabetes website, health website, and book and also from the doctor. It uses Macromedia Dreamweaver as the system is developed and in web based format. MySQL tool is used as database management.

Scopes for this system are:

i. Identify symptoms of diabetes in order to design the proper rules
ii. Capture the rules as part of expert system within the Diabetes Detection System
iii. Implement an online Diabetes Detection System as a mobile application

1.5 STUDY MODULE



1.6 THESIS ORGANIZATION

This thesis consists of five (5) chapters. Chapter 1 discusses the introduction to the system. The discussion consists of system overview. Problem statements elaborate the problem that is faced by the current system. On objectives, the reasons for the development of project are listed. Scope of the project is discussed on project and user limitation.

Chapter 2 reviews the previous research work that have been conducted by other researchers. All the relevant websites, journal, technical paper and books taken from those researcher will be discussed in detail.

Chapter 3 will discuss on system methodology. It will discuss the methods that are used to develop the system and project planning. In this chapter, it will also discuss the needs of the project such as the software and the device that are needs to develop the system.

Chapter 4 will discuss on project implementation. This chapter will discuss on design of project development.

Chapter 5 will discuss on lessons learned. In particular, the conclusion on the implementation as well as the methodology will be highlighted along with the scope for future work.

CHAPTER II

LITERATURE REVIEW

This chapter briefly discusses about literature review of Diabetes Detection System (DDS) Using Rule-based Technique (DDS). Furthermore, information and detail about diabetes diseases also have been briefly discuss in this chapter. Besides that, several methods and technique from previous study are explained through this chapter. Most of the case studies are from several websites, articles and journals based on previous researches and studies about expert system.

2.1 Introduction

Diabetes is one of the common diseases nowadays which attack almost various age groups. According to the Malaysian Diabetes Association (2006), there are nearly 1.2 million people in our country, Malaysia who suffer diabetes. Presently, the figure have been increased to three million people in 2011. According to the news in the TheStar Online (2010), the number of diabetics in the country has increased by almost 80 percent in the last 10 years from 1996-2006 to 1.4 million adults above the age of 30.

Besides that, according to the Director Health Tan Sri Dr Mohd Ismail Merican said obesity was another trend in Malaysia, since the National Health and Morbidity Survey in 2006, showed that the number of obese had also increased by almost 200 percent over a 10-year period from 1996.Furthermore, according to the New Straits Times (2 Aug 2010), The National Health and Morbidity Survey 2006 revealed that the national prevalence of diabetes among senior officers and managers was 15.9 per cent, the second highest after the unemployed (16.1 per cent).While, the housewives ranked the third 14.2 percent followed by the technical workers that is 12.1 percent, machine operators 11.7 percent, services and shop workers 10.7 per cent and the professional 10 per cent.

As we know, diabetes is a chronic disease that has no cure and which is due to the body does not able to produce the insulin that is required by human body to convert the sugar, starches and other food into energy needed for daily life. Diabetes prevalence increase with increasing age, approximately half of the diabetes cases occur in the average age more than 55 years old. Furthermore, nowadays even babies and young children get affected of these diseases due to certain factors.

2.2. Diabetes

Diabetes is one of the major leading of death mostly in many developed country. Furthermore, diabetes is a disease which related to the blood glucose level is too high in the body. Normally, we obtained glucose (simple sugar) from the meal that we take. The glucose is released into the blood and the pancreas is responsible to release the insulin where it's used as energy. Basically, healthy pancreases adjust the amount of insulin that produced based on the level of glucose in body. However, if the body is affected by diabetes, the pancreas would keep on undergoing the breaks down process causing excessive glucose in body can cause many serious problems such as it can damage eyes, kidney, and nerves.

2.3 Type of Diabetes

There are three major types of diabetes such as Pre-Diabetes, Type 1, Type 2 and Gestational diabetes. However, the causes and the risk factors for each type are different. Basically, the major factors that cause a person suffer with diabetes are due to genetic disorder that related to family history of diabetes and environmental which refer to their life styles. Diabetes that due to the genetic disorders are commonly related to the family history of diabetes which is clarified as Type 1 Diabetes. Mostly people or the parents who suffer from diabetes have high worry that their children will therefore have it, although the reality is not simple as mentioned. Diabetes is not hereditary, although the risk factors that a person has are passed down through the genes, therefore making it more likely that the next generation will have it. An estimated 80% of those diagnosed with diabetes each year have at least one family member who already has diabetes. While, the unhealthy lifestyles can also cause a person suffer diabetes due to increase in caloric intake and lack of exercise which could lead to Type 2 Diabetes.

2.3.1 Pre-Diabetes

Pre-diabetes is the early stage which is known as “gray area” between normal blood sugar and diabetic level. Basically, people with pre-diabetes have glucose level that is higher than normal but it’s not high enough to be declared as diabetes. Usually, the patient with pre-diabetes don’t have any symptoms but they we’re at high risk of developing type 2diabetes as well as medical problems associated with diabetes. According to the Diabetes Health Centre, with pre-diabetes a patient are at 50% higher risk of heart disease and stroke rather than someone who does not have pre-diabetes.

In order to determine whether a patient have pre-diabetes, they can perform one of three different blood tests – the fasting plasma glucose (FPG) test, the oral glucose tolerance test (OGTT) or the Hemoglobin A1C (or average blood sugar) test. Normally, blood glucose levels for pre-diabetes patient are 100-125 mg/dl after an overnight or eight-hour fast. People with these results are considered to have impaired fasting glucose (IFG). However, if blood glucose levels of 140-199 mg/dl after the OGTT is diagnosed as pre-diabetes. People with these results are considered to have impaired glucose tolerance (IGT).

2.3.2 Type 1

Type 1 Diabetes is a disease in which the pancreas does not produce insulin. If the patient has type 1 diabetes, glucose builds up in the blood instead of being used for energy. The cause of type 1 diabetes remains unknown. However, it is not preventable, and it is not caused by eating too much sugar. The body’s defense system may attack insulin-making cells by mistake, but we don’t know why. People are usually diagnosed with type 1 diabetes before the age of 30, most often during childhood or their teens.

The risk of developing type 1 diabetes is higher than virtually all other chronic disease of childhood. Usually, has been proved in many researches the type 1 diabetes tends to attack in family members who have about 10 per cent chances of developing the disease. For example, identical twin of a person with type 1 diabetes has at least 50 times the risk of developing the diabetes rather than a child from unaffected family.

According to the Emedicine Health stated that Type 1 diabetes may occur in families and slightly more common in men rather than women. Among children under age 15, the risk of developing type 1 diabetes has been increasing since the 1950s around the world. The increase has been very rapid, particularly in the youngest children, under age 5 (Diamond Project Group 2006).Furthermore, this type is very common in Asian descent. Besides that, this can occur at any age but it most often diagnosed in children and teenagers.

2.3.3 Type 2

Type 2 Diabetes, which is known as Non-Insulin Dependent is due to metabolic disorder resulting from the body's inability to make enough or properly use insulin. Even though, the pancreas secretes insulin, but the body is partially or completely unable to use the insulin. People with insulin resistance develop type 2 diabetes when they do not continue to secrete enough insulin to cope with the higher demands. Almost 90% of the patients suffer type 2 diabetes, and usually occur after the age 45 years. This form of diabetes usually begins with insulin resistance, a condition in which fat, muscle, and liver cells do not use insulin properly. At first, the pancreas keeps up with the added demand by producing more insulin. In time, however, it loses the ability to secrete enough insulin in response to meals. Being overweight and inactive increases the chances of developing type 2 diabetes. Treatment includes using diabetes medicines, making wise food choices, being physically active, taking aspirin daily and controlling blood pressure and cholesterol.

However, more than half of all people with type 2 diabetes require insulin to control their blood sugar levels at some point in the course of their illness and most of them do not know they have these diseases. Another type of diabetes is the gestational diabetes which is a form of diabetes that occurs during the second half of pregnancy. Other than that, gestational diabetes would goes away after delivery of the baby and the women with this type of diabetes are more likely to have large sizes of babies.

2.4 Symptoms

People that suffering with diabetes disease frequently experience certain symptoms such as being very thirsty, frequent urination, weight loss, increased hunger, blurry vision, irritability, frequent skin infections ,wounds that don't heal and extreme unexplained fatigue. However, in some cases there are no symptoms faced by the patient. Usually this occurred to the patient who suffers Type 2 diabetes. In this case, people can live for months, even years without knowing they have the disease. This form of diabetes comes on so gradually that symptoms may not even be recognized.

However, the most consistent symptom of diabetes mellitus (Type 1 & Type 2) is elevated blood sugar levels. Type 1 is caused by the body not producing enough insulin to properly regulate blood sugar, while in Type 2 diabetes, is caused by the body developing resistance to insulin. Ignoring the diabetes symptom at early stage can lead to long-term serious health risk and complications that may lead to other fatal diseases. Below shows some common "early sign "of diabetes:

Type 1 Diabetes

- Frequent urination
- Unusual thirst
- Extreme hunger
- Unusual weight loss
- Extreme fatigue and Irritability

Type 2 Diabetes

- Any of the type 1 symptoms
- Slow healing of wounds
- Blurred vision
- Cuts/bruises that are slow to heal
- Tingling/numbness in the hands/feet
- Dry or Itchy skin, gum, or bladder infections

2.5 Treatment

There is some treatments conduct by the medical area in order to cure this disease. As we know, type 1 diabetes can be a preventable disease thus an alternative treatment is required to identify in the early stage. There are some alternative treatments that have been studied to manage diabetes including acupuncture, biofeedback, guide imagery and medicine supplementation.

Acupuncture is a procedure in that a practitioner inserts needles into designated points on the skin. Some Western scientists believe that acupuncture triggers the release of the body's natural painkillers. Acupuncture and herbal medicine have been used to treat diabetes for over 2000 years. According to a report in the 1994 Journal of Traditional Chinese Medicine as a model of Chinese research on acupuncture, diabetes is caused by an imbalance of the cyclical flow of Qi within the meridians and organ system. It is used by people with neuropathy, the painful nerve damage of diabetes.

Figure 2.1: Chinese Acupuncture treatment

Besides the acupuncture treatment, usually the people who suffer with diabetes sometimes would use the oral medications to cure these diseases. Regularly, the patient who begin with tis oral treatment need to take insulin. These types of medications required the pancreas to make some insulin by using the sulfa drugs. Probably, the patient can take the medications at the same times every day. However, this kind of treatment has some effect such as low blood sugar, an upset stomach, skin rash and weight gain.

Figure 2.2: Oral treatments for diabetes patient.

Sometimes, the patient would take some oral diabetes tablets in order to help the body cells to take in glucose for energy and the pancreas to produce the insulin. However, a number of Type 2 diabetics will need to change to insulin injection because the oral tablets are no longer as effective as it used to be.

Besides that, mostly some of the people would go for blood sugar testing. It is an essential part of diabetes care and it prevents long-term complications. The number of test is carried put is depend on many factors, including the type of diabetes a patient suffer. For example, for type 1 the doctor would recommend blood sugar testing at least three times a day while for type 2 ,if the patient take insulin the doctor would recommend blood sugar testing one to three times a day depends on the number of insulin doses the patient take. Usually, the blood sugar testing requires a blood sugar monitor. The monitors are large with easy-to-handle test strips, while others are compact and easier to carry. The blood is taken from the fingertips which contain a lot of nerve endings.

Furthermore, there are two blood tests that can help a patient manage their diabetes. One of these tests is called an A1C test, which reflects blood sugar (or blood glucose) control over the past 2-3 months. Testing the A1C level every 3 months is the best way for the patient and the doctor to understand how well the blood sugar levels are controlled. The A1C goal will be determined by the doctor, but it is generally less than 7%. While, another test is called SMBG, or self-monitoring of blood glucose.

Other than that, there are also several test are used to diagnosis the diabetes such as fasting plasma glucose test (FPG) which is to measure the blood glucose in a person who has not eaten anything for at least 8 hours in order to detect diabetes or pre-diabetes, oral glucose tolerance test (OGTT) in order to measure the blood glucose level after a person fasts at least 8 hours and 2 hour after the person drinks a glucose containing beverage and a random plasma glucose test to measures blood glucose level without regard to when the person being tested last ate. Below are the table that shows the result of FPG and OGTT:

Table 2.1 Fasting Plasma Glucose Test

Plasma Glucose Result (mg/dL)	Diagnosis
99 or below	Normal
100 to 125	Pre-diabetes (impaired fasting glucose)
126 or above	Diabetes*

Table 2.2 Oral Glucose Tolerance Test

2-Hour Plasma Glucose Result (mg/dL)	Diagnosis
139 and below	Normal
140 to 199	Pre-diabetes (impaired glucose tolerance)
200 and above	Diabetes*

Table 2.3: Gestational diabetes: Above-normal results for the OGTT

When	Plasma Glucose Result (mg/dL)
Fasting	95 or higher
At 1 hour	180 or higher
At 2 hours	155 or higher
At 3 hours	140 or higher

Lastly, although there is no cure for diabetes, advances in diabetes treatment are being made all the time. The Diabetes Control and Complications Trial (DCCT) and other studies show that people can and do healthy lifestyles to overcome the diabetes. Besides that, having careful meal planning and exercise may help patient with type 1 diabetes reduce the amount of insulin they take, stay within their target range, and feel better.

2.2.5. Preventation

Serious action should need to be taken by each individual in order to reduce the number of people that suffer with diabetes disease from the early stage. Thus, there are some steps can be taken to overcome it, for example if the patient has type 2 diabetes, it may be possible for him to stop taking medicine one day. Some people with type 2 diabetes are able to manage diabetes by treating it with exercise and careful meal planning.

Other than that, lifestyle modification or certain medications can be used in people with Pre-diabetes to prevent progression to diabetes. Besides that, if someone already know that they have diabetes, they focus should be on preventing the complications, which can cause serious disabilities such as blindness, kidney failure requiring dialysis, amputation, or even death. Furthermore, having a healthy diet also required in order to prevent diabetes. For example, pay attention to your genetics, and to your ethnic group's traditional foods. Stay away from fat-free foods which cause your insulin levels do a yo-yo, and that makes you put on fat.

Besides that, having healthy lifestyles through exercise are also needed for a diabetic patient. Walking is a great exercise. Do it every day, and you'll raise your metabolic rate, as well as level out your blood sugar. This means you will burn extra calories even while you are sitting in front of your computer or sleeping in your bed. Pay attention to what you do and think of how you can burn more calories while doing it. (Mark Lamendola, Mindconnection.com.).

2.6 Expert System

An expert system is computer programs that are called as Artificial Intelligence. Usually, the term expert system is used for any computer programs whose knowledge base contains the knowledge used by human experts, in contrast to knowledge gathered from textbooks or non-experts. Expert system consists of two principal parts that is knowledge base and the reasoning or inference.

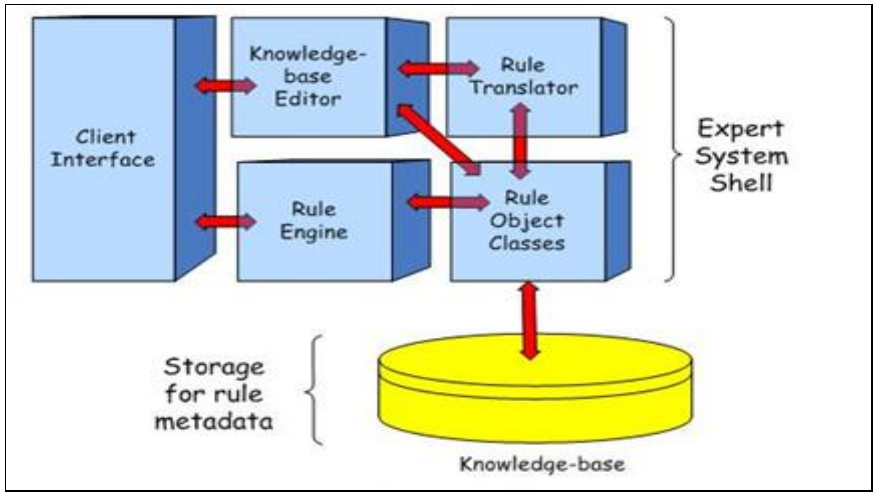


Figure 2.3: Components Expert System

Architecture of expert system is consist of set of rules that derived from the knowledge base and used by the interpreter to evaluate the inputted data, knowledge engineer which decides how to represent the experts knowledge and how build the inference engine appropriately for the domain and interpreter which responsible to interprets the inputted data and draws a conclusion based on the users responses.

There are two types of problem solving models for expert system that is forward chaining and backward chaining. Forward chaining is starts from a set of conditions and moves towards some conclusion while backward chaining starts with a list of goals and the works backwards to see if there is any data that will allow it to conclude any of these goals. Those both methods are built into inference engines or inference procedures.